

# TABLE OF CONTENTS

Page

The opinions expressed in this paper are those of the author, a caribou biologist of long standing, and not necessarily those of the Department of the Environment or the Canadian Nature Federation.

1. Introduction	3
2. The caribou of the Yukon	3
2.1 The caribou of the Yukon	3
2.2 The caribou of the Yukon	3
2.3 The caribou of the Yukon	3
2.4 The caribou of the Yukon	3
2.5 The caribou of the Yukon	3
2.6 The caribou of the Yukon	3
2.7 The caribou of the Yukon	3
2.8 The caribou of the Yukon	3
2.9 The caribou of the Yukon	3
2.10 The caribou of the Yukon	3
3. The caribou of the Yukon	3
3.1 The caribou of the Yukon	3
3.2 The caribou of the Yukon	3
3.3 The caribou of the Yukon	3
3.4 The caribou of the Yukon	3
3.5 The caribou of the Yukon	3
3.6 The caribou of the Yukon	3
3.7 The caribou of the Yukon	3
3.8 The caribou of the Yukon	3
3.9 The caribou of the Yukon	3
3.10 The caribou of the Yukon	3
4. The caribou of the Yukon	3
4.1 The caribou of the Yukon	3
4.2 The caribou of the Yukon	3
4.3 The caribou of the Yukon	3
4.4 The caribou of the Yukon	3
4.5 The caribou of the Yukon	3
4.6 The caribou of the Yukon	3
4.7 The caribou of the Yukon	3
4.8 The caribou of the Yukon	3
4.9 The caribou of the Yukon	3
4.10 The caribou of the Yukon	3
5. The caribou of the Yukon	3
5.1 The caribou of the Yukon	3
5.2 The caribou of the Yukon	3
5.3 The caribou of the Yukon	3
5.4 The caribou of the Yukon	3
5.5 The caribou of the Yukon	3
5.6 The caribou of the Yukon	3
5.7 The caribou of the Yukon	3
5.8 The caribou of the Yukon	3
5.9 The caribou of the Yukon	3
5.10 The caribou of the Yukon	3
6. The caribou of the Yukon	3
6.1 The caribou of the Yukon	3
6.2 The caribou of the Yukon	3
6.3 The caribou of the Yukon	3
6.4 The caribou of the Yukon	3
6.5 The caribou of the Yukon	3
6.6 The caribou of the Yukon	3
6.7 The caribou of the Yukon	3
6.8 The caribou of the Yukon	3
6.9 The caribou of the Yukon	3
6.10 The caribou of the Yukon	3
7. The caribou of the Yukon	3
7.1 The caribou of the Yukon	3
7.2 The caribou of the Yukon	3
7.3 The caribou of the Yukon	3
7.4 The caribou of the Yukon	3
7.5 The caribou of the Yukon	3
7.6 The caribou of the Yukon	3
7.7 The caribou of the Yukon	3
7.8 The caribou of the Yukon	3
7.9 The caribou of the Yukon	3
7.10 The caribou of the Yukon	3
8. The caribou of the Yukon	3
8.1 The caribou of the Yukon	3
8.2 The caribou of the Yukon	3
8.3 The caribou of the Yukon	3
8.4 The caribou of the Yukon	3
8.5 The caribou of the Yukon	3
8.6 The caribou of the Yukon	3
8.7 The caribou of the Yukon	3
8.8 The caribou of the Yukon	3
8.9 The caribou of the Yukon	3
8.10 The caribou of the Yukon	3
9. The caribou of the Yukon	3
9.1 The caribou of the Yukon	3
9.2 The caribou of the Yukon	3
9.3 The caribou of the Yukon	3
9.4 The caribou of the Yukon	3
9.5 The caribou of the Yukon	3
9.6 The caribou of the Yukon	3
9.7 The caribou of the Yukon	3
9.8 The caribou of the Yukon	3
9.9 The caribou of the Yukon	3
9.10 The caribou of the Yukon	3



# TABLE OF CONTENTS

	Page
ABSTRACT .....	1
1. Introduction .....	1
2. The present and past status of some northern caribou populations in Canada and Alaska .....	1
3. Causes of population declines .....	3
3.1 Overhunting .....	3
3.2 Predators other than man .....	5
3.3 Forage restrictions .....	6
3.4 Parasites and disease .....	7
3.5 Climatic extremes .....	8
3.6 Social pressures - Emigration .....	8
3.7 Combinations of factors .....	8
4. Past attempts to manage barren-ground caribou populations in Canada and Alaska .....	9
4.1 Harvest reduction .....	9
4.1.1 Self restraint - education .....	10
4.1.2 Legal restrictions .....	10
4.1.3 Preserves .....	11
4.1.4 Reduced hunting because of sociological or economic changes .....	12
4.2 Predator control .....	12
4.3 Fire suppression .....	12
4.4 Preventing or minimizing the impact of industrial development .....	12
5. Demographic and political characteristics of user groups .....	13
5.1 Rate of growth of user populations .....	13
5.2 Land claims .....	13
6. The value of caribou .....	13
7. Why are we at the crossroads? .....	14
8. Conclusions .....	17
9. Literature Cited .....	17





## ABSTRACT

Several major populations of caribou in Canada and Alaska have declined sharply in this decade with overharvest a common denominator. A review of what is known about the causes of these declines, of past attempts to manage populations, and of demographic characteristics of the user groups leads to the conclusion that hunting must be curtailed soon or some populations in northern Canada will be reduced to an insignificant resource or extirpated.

Action must be taken quickly to curb these caribou declines because recovery from population lows can take 1 to 3 decades. Meanwhile the population of the hunting villages is doubling every 16 to 20 years and land claims may delay implementation of restrictions.

Solutions will be extremely difficult to achieve until all land claims are settled, but interim action is needed to save the Kaminuriak caribou population and to maintain adequate numbers in some of the others. Wolf control is needed to speed the recovery of the Kaminuriak and Beverly populations but without harvest quotas it will not save them. One approach to curbing the kill by hunters is an educational program with a goal of voluntary self-restraint (essentially self-management) by the user group. A second solution is some form of restriction imposed on the people by the management agencies with the involvement and support of hunter associations. My view is that the first approach will not work in the short term and possibly not in the long run; but, in the present political climate, it is a prerequisite to attempted deployment of the second.

### 1. Introduction

The purpose of this paper is to review briefly the dynamics of some of the larger populations of caribou in Canada, to comment on their present status, to identify causes of the observed declines in numbers, to comment on forms of caribou management, to discuss changes in the communities of hunters and to point out why we are at a critical period in the management of the extremely valuable caribou resource.

### 2. The present and past status of some northern caribou populations in Canada and Alaska

Calef (1978), in a review of populations (herds) of barren-ground caribou (Rangifer tarandus groenlandicus) in the Northwest Territories, estimated there were 626,000 caribou in 9 herds. Population estimates as of 1977 were: Porcupine 100,000, Bluenose 90,000, Bathurst 150,000, Beverly 124,000, Kaminuriak 44,000, Lorrillard 17,000, Wager Bay 29,000, Melville Peninsula 52,000, and Baffin 20,000. At that time some populations were considered to be increasing, others were stable and some were decreasing, depending on the percentage of hunting mortality. In





addition to the 626,000 barren-ground caribou there were about 178,000 caribou (1976 estimate) in the George River population in Quebec-Labrador, which are classified as woodland caribou (R. t. caribou), but they are more like the barren-ground subspecies in their migratory behaviour and range selection. That population was increasing at a rate of about 12% a year during the mid 1970's (I. Juniper pers. comm.).

Recent information is that the Porcupine population has been relatively stable in the past few years, while considerable declines were recorded in the Bathurst, Beverly, Kaminuriak and Baffin populations. One of the best documented declines is in the Kaminuriak population: from about 149,000 in 1955 to 63,000 in 1967, 44,000 in 1977 and 39,000 in 1980. The Beverly population increased from 159,000 in 1967 to 210,000 in 1971 and then it decreased to 177,000 in 1974, to 131,000 in 1978 and to 94,000 in 1980. The Bathurst population increased from 144,500 in 1967 to 150,000 in 1977 and then decreased to about 90,000 in 1980. (See Figure 1.)

Even greater declines occurred in Alaskan caribou populations between 1970 and 1977. The Western Arctic populations of barren-ground caribou (R. t. granti) decreased sharply from 242,000 to 75,000, the Nelchina from 25,000-60,000 to 14,000, the Fortymile from 10,000-50,000 to 4,000. Similar decreases occurred in smaller populations while others increased in numbers. Excluding the Porcupine population, the overall decrease for all Alaskan populations was from 300,000-400,000 in 1970 to 140,000 in 1977 (Davis et al. 1978).

The herds in Alaska should be termed subpopulations if they periodically emigrate to the range of another herd. (Skoog 1968, Haber 1980). The data for such shifts in Alaska and Canada are weak. The ranges were mapped smaller than they actually were and were mutually exclusive whereas considerable seasonal overlap can occur.

Some of the most spectacular declines in Rangifer occur in populations that winter on the tundra. For example, the western Parry Islands population (Melville, Eglinton and Prince Patrick Islands) of Peary caribou (R. t. pearyi) decreased from over 15,000 in 1961 to 4,200 in 1973, and to 2,300 in 1974 (Miller et al. 1975). Numbers on Bathurst Island decreased from ca 2,700 in 1961 to 700 in 1973, and to 230 in 1974. Those populations have continued to decrease to the present because of little or no recruitment. Caribou on the western Queen Elizabeth Islands (Parry Islands) have decreased from 24,320 in 1961 to 5,244 in 1973, to 2,676 in 1974 and to about 634 in 1980. The 1980 estimate is based on the 1974 estimate and on what is known about pregnancy rates and recruitment of those caribou, and on mortality of adult caribou in general.

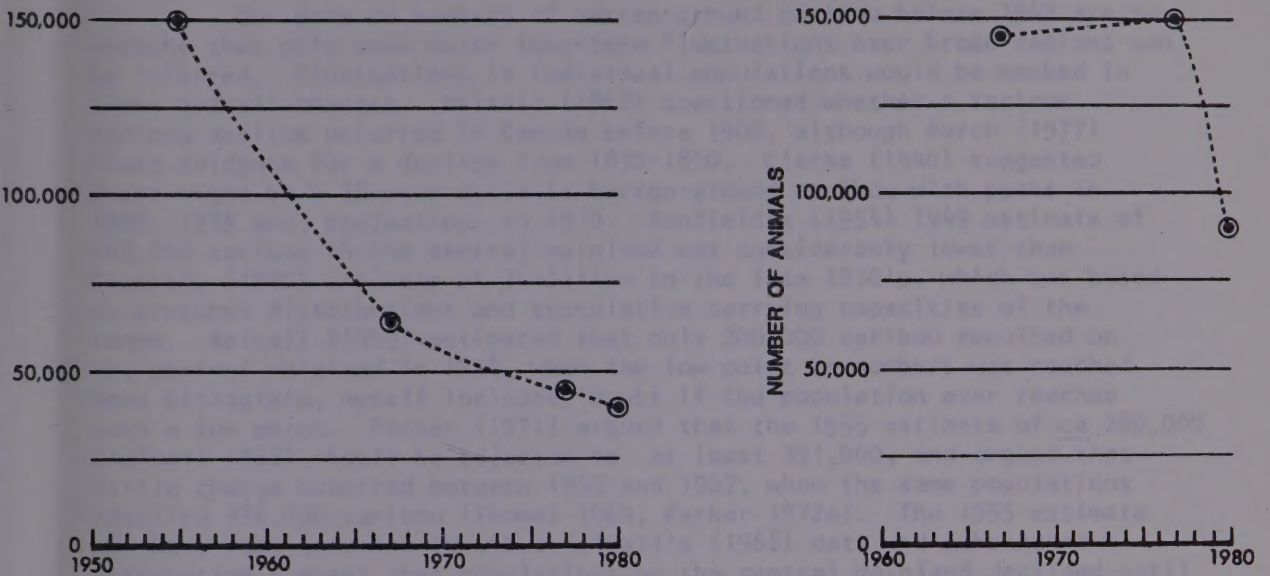
With the mainland populations of barren-ground caribou, some other populations of Peary caribou increased concurrently. Caribou increased on Banks Island during the 1960's and 70's until a die-off occurred in the winter of 1977-78. The only population estimates were 5,300-8,000 in 1970 (Kevan 1974) and 11,000 in 1971 (Urquhart 1973). The





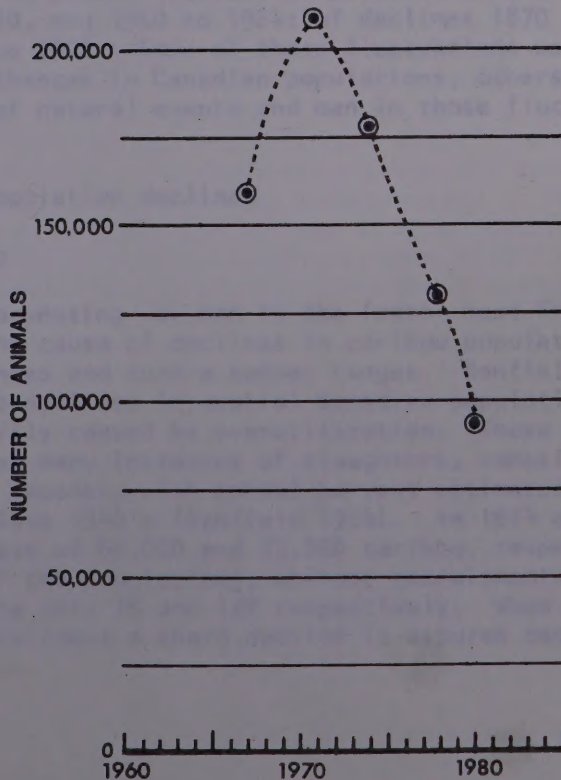
Figure 1

# POPULATION ESTIMATES FOR THREE CARIBOU HERDS



1. Kaminuriak

2. Bathurst



3. Beverly



population of 3,000-5,000 (Renewable Resources 1975) on Somerset and Prince of Wales Islands probably increased during the 1970's because of high productivity (Thomas and Broughton 1978).

Our data on numbers of barren-ground caribou before 1949 are so sketchy that only some major long-term fluctuations over broad regions can be inferred. Fluctuations in individual populations would be masked in those overall changes. Kelsall (1968) questioned whether a serious caribou decline occurred in Canada before 1900, although Burch (1977) found evidence for a decline from 1830-1850. Clarke (1940) suggested there might be a 35-year cycle in barren-ground caribou with peaks in 1900, 1935 and, projecting, in 1970. Banfield's (1954) 1949 estimate of 668,000 caribou on the central mainland was considerably lower than Clarke's (1940) estimate of 3 million in the late 1930's, which was based on presumed distributions and speculative carrying capacities of the range. Kelsall (1968) estimated that only 200,000 caribou remained on the central mainland in 1958, when the low point in numbers was reached. Some biologists, myself included, doubt if the population ever reached such a low point. Parker (1971) argued that the 1955 estimate of ca 280,000 (Kelsall 1968) should be adjusted to at least 391,000, and argued that little change occurred between 1955 and 1967, when the same populations totalled 386,000 caribou (Thomas 1969, Parker 1972a). The 1955 estimate may have been somewhat low, but Kelsall's (1968) data and subsequent information suggest that populations on the central mainland declined until about 1957, when a pronounced upsurge began.

Long-term fluctuations in total caribou numbers in Alaska were also inferred from available data (Skoog 1968). Peak numbers occurred in the 1860's, 1920's, and 1970's. The intervals between peaks and troughs vary from 30 to 60 years. Periods of possible or known rapid increase were 1900 to 1920, and 1950 to 1964; of declines 1870 to 1890, 1925 to 1940, and 1964 to 1976. Some of those fluctuations were roughly in synchrony with changes in Canadian populations, others were not. The relative roles of natural events and man in those fluctuations are not known.

### 3. Causes of population declines

#### 3.1 Overhunting

Overharvesting by man is the factor most frequently cited by biologists as the cause of declines in caribou populations which utilize taiga winter ranges and tundra summer ranges. Banfield (1954) and Kelsall (1968) felt that declines in central Canadian populations from 1940 to 1958 were primarily caused by overutilization. Those authors and Clarke (1940) documented many instances of slaughters, sometimes with considerable waste, in those decades, with annual harvest estimated as high as 86,000-100,000 in the late 1940's (Banfield 1954). In 1954 and 1955, the estimated harvests of 66,000 and 73,000 caribou, respectively, constituted more than 20% of the populations, whereas recruitments (percentages of 1-year-olds) were only 15 and 12% respectively. When hunting mortality exceeds the recruitment a sharp decline is assured because of the





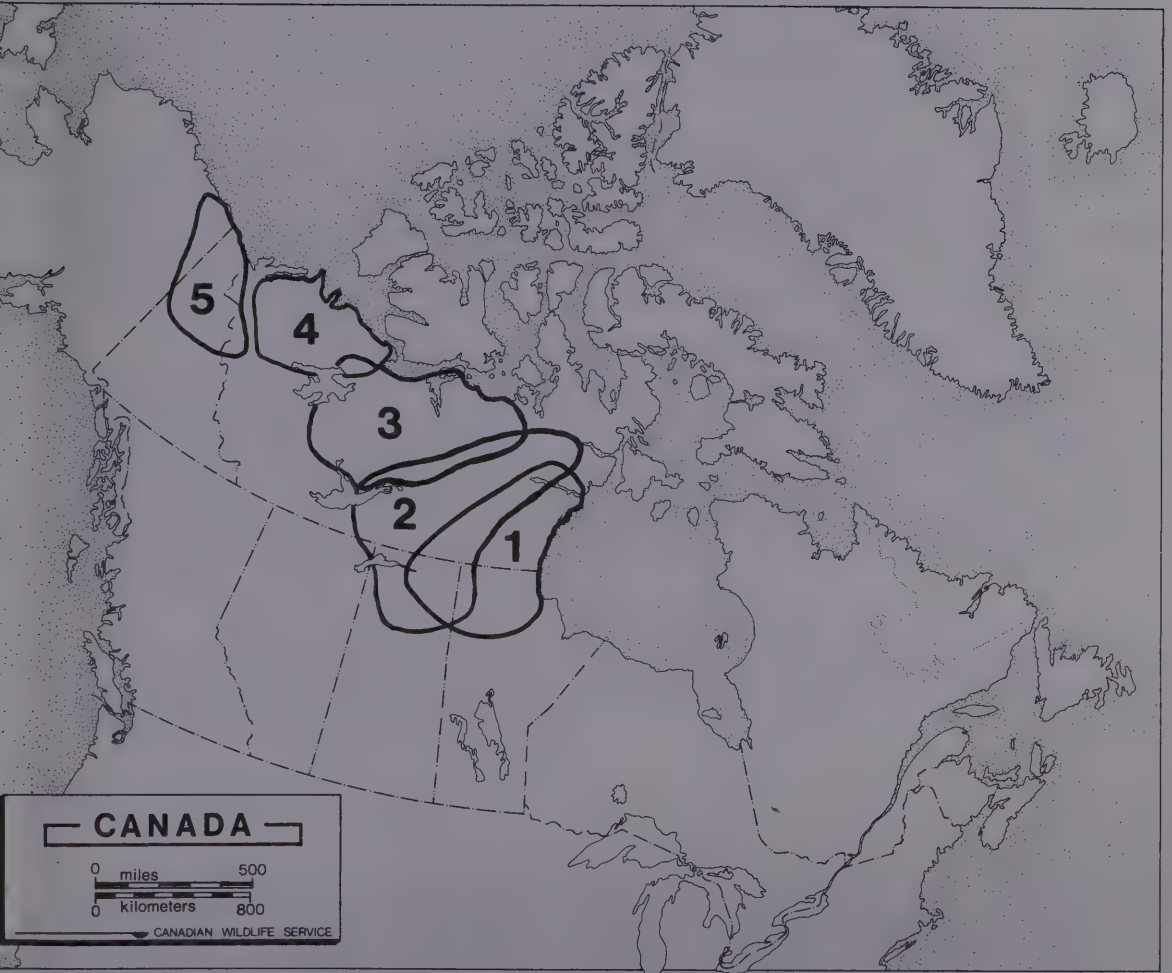
additional natural mortality of yearlings and adults, which amounts to about 7% annually or higher. The average estimated harvest for all Northwest Territories populations of barren-ground caribou from 1972-73 to 1974-75 was ca 18,000 annually (Calef 1978) or 2.9% of the total population. However, some of the averages given by Calef are probably low (e.g. for the Porcupine population) and no adjustment was made for crippling losses and waste, which are commonly estimated at 20%. Therefore, the harvest during the 1970's could have averaged 20,000-25,000 annually.

One of the best documented declines attributable to overutilization in a population on the central Canadian mainland is in the Kaminuriak. In 1948-49, the kills in northern Manitoba and southern Keewatin were estimated at 32,000 and 10,000 respectively (Lawrie 1948). The following year, Banfield (1954) estimated that 38,000 caribou were harvested from the same regions, which constituted 32% of the estimated population of 120,000. Those kill estimates may have been high, the harvest levels atypical, and the population estimate low in light of Loughrey's (1955) estimate of 149,000 caribou in the same region in the spring of 1955. Conservation officers in northern Manitoba estimated annual harvests for the Brochet area of 7,400 in 1953-54 and 30,000+ in 1954-55, and 36,000+ for northern Manitoba in 1952-53 (Kelsall 1968). Thus, the slide to 63,000 caribou in 1968 (Parker 1972a) can be attributed to over-harvest -- marked animals discount emigration and immigration as the cause of fluctuations (Parker 1972b). Furthermore, the continued decline from 63,000 in 1968 to ca 44,000 in 1977 can be explained by overharvest. Kill data for Keewatin District (Fischer et al. 1977) indicate an average harvest of the Kaminuriak population, for the period 1967-69 to 1975-76, of ca 3,800 animals. Adding 20% for wounded and unretrieved caribou brings the total to ca 4,600. As explained by Usher (1975) and Interdisciplinary Systems (1978), kill estimates derived from Northwest Territories General Hunting Licenses are probably low. Furthermore, in compiling the totals, there was an assumption that only half of the Baker Lake harvest was from the Kaminuriak population when, in fact, the proportion was probably much higher (comments of Baker Lake hunters in Payne 1978). Furthermore, whereas the average harvest from the Kaminuriak population ascribed to Baker Lake in the harvest data was 955 (Fischer et al. 1977), the harvest at Baker Lake in 1976-77 was estimated at 4,100 (Interdisciplinary Systems 1978). Most of that kill came from the Kaminuriak population, when one component of it spent most of the winter near the community (Fischer et al. 1977). In 1977-78 the Kaminuriak population wintered near Inuit villages once again and harvests were substantial. Taking all those factors into account, and adding 500 as the average harvest in northern Manitoba, the average hunting mortality in the Kaminuriak population from 1968-69 to 1977-78 was probably 5,000 (4,000-6,000) annually rather than 3,000 (Simmons et al. 1979). As the population decreased, the proportion of the population taken by hunters increased sharply from ca 6.5% in 1967-68 (harvest of 3,300 yearlings and adults adjusted to 4,125, population 63,000) to ca 9-11% in 1974-77 (harvest 4,000-5,000, population 44,000), to ca 12% in 1977-78 (harvest ca 5,000, population ca 42,000) and to 12% in 1979-80 (harvest ca 4,700, population ca 39,000).





Figure 2



The major herds of barren-ground caribou  
on the mainland of Canada:

- 1 Kaminuriak
- 2 Beverly
- 3 Bathurst
- 4 Bluenose
- 5 Porcupine



In order to maintain approximately a constant population size, the allowable harvest of caribou over 1 year of age should equal recruitment less the natural mortality rate of caribou older than 1 year. The harvest quota should be reduced according to the proportion of calves in the kill. Then it must be increased by a factor of 1.25 to account for wounded and unretrieved caribou, estimated at 20% of the total. Differential mortality among sex and age groups can alter this simplistic equation but it is adequate considering the reliability of the statistics that are fed into it.

I detailed the history of the Kaminuriak population because it is a text book case of overharvest. The term overharvest does not mean that hunters are taking more caribou than they need. It means that as a group they are taking more than the caribou populations can withstand in order to maintain their numbers. Action is needed very soon to save that resource.

The Beverly population in 1978-79 was accessible to many settlements and the kill was high. The following winter the main segment of the population wintered relatively deeply in Saskatchewan and preliminary estimates of the harvest indicate that at least 20,000 caribou were killed throughout the range that year. Continuance of such an unusually high kill for 5 years would result in loss of the population.

The sharp decline in the Western Arctic population in Alaska was also directly attributable to overhunting. That population decreased from 242,000 in 1970 to a low of 75,000 in 1976 (Davis et al. 1980). From 1963 to 1976-77, a period of no restrictions on the harvest, the annual kill was estimated at 20,000-30,000. A retrieved harvest of well over 20,000 in 1975-76 was accompanied by wounding and waste of several thousand more, waste that in the words of Alaskan biologists could not be justified either biologically, morally, socially or ethically (Davis et al. 1978b).

The initial decline in the Fortymile population from 500,000 in the 1920's to 15,000 in 1970 was blamed on emigration and overhunting by white sportsmen. Estimated harvest by trappers during the 1930's was 10,000 caribou a year (Skoog 1968).

### 3.2 Predators other than man

I know of no conclusive evidence to suggest that predators have ever caused the decline of barren-ground caribou populations. Bergerud (1980) cited examples where herds supposedly declined when hunting was supposedly negligible and predator numbers were high. However, factors other than predation cannot be excluded and data from only 1 or 2 years is inadequate. Bergerud (1974) implicated predators and disease as important factors in declines of woodland caribou. His thesis was that the numbers of predators and the incidence of disease rose because fire and logging created new habitat which resulted in an increase in the numbers of alternate prey species, some of which harboured parasites transmissible to and harmful to caribou.





That wolves contribute substantially to the annual mortality in barren-ground caribou is not disputed (Murie 1944, Kelsall 1968, Miller and Broughton 1974, Davis et al. 1978a). Average annual mortality of about 5% in yearlings and adults within herds on the central Canadian mainland was ascribed to wolf predation (Banfield 1954, Kelsall 1968, Parker 1972). Bergerud (1980), in a review of factors which affect the population dynamics of caribou in North America, concluded that the annual adult mortality rate varied from 7-13% (mean 10%) if predators were common and 5-6% if they were rare. Data for the Western Arctic Herd in Alaska suggested that the natural mortality rate was 7-9% (Davis et al. 1980).

The greatest impact of predation is on calves, however. Wolf predation was the primary cause of calf mortality on the calving grounds of the Kaminuriak population (Miller and Broughton 1974). There was some evidence that the high mortality rate in calves on the calving grounds of the Beverly population in June 1978 was caused by wolves (Calef pers. comm.). Wolves are undoubtedly the major cause of mortality to calves during the summer and winter.

Recently, Davis et al. (1978a) found there was abundant circumstantial evidence that wolf predation was the principal factor limiting the Fortymile population in Alaska. Haber (1977) and Haber and Walters (1980) believe that wolves may prevent caribou populations from recovering after a population decline, at least in regions where alternate prey species are present. Bergerud (1980) believes that predation is the chief limiting factor to population growth and that it prevents caribou from achieving densities higher than 0.4-0.8/km<sup>2</sup>.

The only documented cases of Rangifer overutilizing their entire ranges are in predator-free island environments (Scheffer 1951, Klein 1970). That evidence supports the view that wolves have considerable regulatory impact on caribou and reindeer populations, although other factors were involved such as the lack of flies and the lack of need to migrate long distances.

### 3.3 Forage restrictions

Most biologists agree that available forage on winter ranges is the key factor governing the potential upper limit of population size (Klein 1970). Winter range refers to the total winter environment: landscape, forage, snow, ice, and other climatic variables. "Environmental resistance" in winter is measured by decreased availability of good quality forage and increased energy expenditures in obtaining forage, travelling, avoiding predators, and maintaining body temperature.

Caribou that winter on the tundra are subject to periodic mass starvation and therefore may seldom or never attain the carrying capacity of available forage within their ranges. Malnutrition may result entirely from inaccessibility of forage (Parker et al. 1975, Miller et al. 1975), or it may stem from a combination of local forage depletion and inaccessibility,





which has occurred on predator-free islands (Scheffer 1951, Klein 1968). Caribou that usually migrate from tundra to taiga for the winter period are not subject to the same phenomena. Incidents of starving caribou in the taiga are extremely rare (Scotter 1964) and cases of mass mortality non-existent. The mobility of caribou, coupled with their flexibility in range selection and use, is one reason. A second reason is the reserve supply of arboreal lichens which become accessible in years of deep snow.

One suggested cause of past declines of caribou was winter range destruction by fire (Leopold and Darling 1953, Edwards 1954, Scotter 1964). The primary mechanism was believed to be destruction of slow-growing and slow-colonizing ground lichens, which, when available, are an important component of the winter diets of caribou. Other possible mechanisms include the interference of burned regions with migration and movements and their unpleasant odour. However, no one has ever shown that winter range was inadequate because of fire destruction. The usual observation is that only a small fraction of available winter range is used in any one season, or over several winters.

A review of the work regarding the influence of fires on the winter range of caribou leads one to the conclusion that a certain annual rate of burning, say 0.5% of the land surface, may be beneficial. It recycles nutrients, opens the canopy, destroys necrotic lichen material and other detritus, stops encroachment of bogs and fens and stimulates growth of grasses, sedges, and shrubs which form part of the diet of caribou, especially in early winter (Miller 1980). The optimum rate will vary regionally and according to habitat type and will depend on subsequent winter climate, a variable factor of little predictability. Fire incidence estimates over periods of a decade or two for several locations on the winter range of caribou fall in the range 0.5-1% annually.

### 3.4 Parasites and disease

Bergerud (1974) believed that faunal changes precipitated by increased numbers of fires, logging, and settlements could have resulted in diseased woodland caribou. The meningeal worm Parelaphostrongylus tenuis, when transmitted from its normal host, white-tailed deer, to caribou, can result in mortality. Such a mechanism was thought to have caused the recent extirpation of caribou from Cape Breton Island (Dauphiné 1975).

The warblefly (Oedemagena tarandi) and nose botfly (Cephenomyia nasalis) can harass caribou in summer when replenishment of fat reserves is crucial. Heavy infestation of those parasites was a source of calf mortality in 1978-79 in the Western Arctic Herd (Davis et al. 1980). Blood-sucking insects, especially mosquitoes (Aedes spp.) and blackflies (Simulium spp.), inflict blood losses as well as harassment. Few deaths are attributed directly to any of these insects but their cumulative effects in some summers may result in high losses to predators and significant energy losses.



### 3.5 Climatic extremes

Climatic extremes during winter can result in mass mortality in populations located on arctic islands, but these events are treated under forage as an availability factor. Severe storms at the height of calving as documented in 1958 (Kelsall 1968) and 1978 (Calef pers. comm.) can result in loss of a significant proportion of the calves. A summary of the known facts is that climatic extremes, other than snow and ice which affect accessibility of forage, are only of local importance in some years. The effects of climatic variability may result in subtle changes in productivity and mortality which may have substantial cumulative impacts.

### 3.6 Social pressures

Skoog (1968) theorized that declines in caribou subpopulations in Alaska were caused by emigration to other ranges when populations exceeded a threshold density of 1.9-3.9 caribou/km<sup>2</sup>. Haber (1977) subscribes to the theory, inferring that emigration was to less suitable range where mortality was higher. There is no conclusive evidence for significant interchange among populations in Canada even though the ranges overlap seasonally. The data on caribou tagged on the ranges of the Kaminuriak (Miller and Robertson 1967), Beverly and Bathurst populations (Parker 1972b) indicate a low rate of interchange.

### 3.7 Combinations of factors

Bergerud (1974) argued that most or all declines in caribou populations around the turn of the century could be attributed to overharvest and increased predation. He has, however, no data to support his argument for an increase in the rate of predation on the large barren-ground caribou populations, a simple system with essentially one prey and one predator. If, because of human predation, the rate of predation by e.g. wolves increases because fewer caribou are available to a fixed number of wolves, a temporary situation, then overhunting by man is the primary cause. If the activity of man in his hunting pursuits causes an increase in the wolf population by providing orphaned calves, which are presumably more susceptible to wolves, or dead and crippled caribou for scavenging by wolves at critical times, then man is the cause.

I believe that overharvest and climatic variability are primarily responsible for declines in barren-ground caribou population and that both alter the predator-prey equilibria. Man with modern weapons and machines is superimposed on the natural system which would be expected to undergo pronounced fluctuations in his absence. Such fluctuations would be caused largely by climatic changes but the role of parasites and diseases cannot be overlooked.

Some effects of climatic variability are well documented. Rain and wet snow cause mortality of young calves (Kelsall 1968, Calef pers.





comm.), relatively warm summers with little wind cause extreme fly harassment which results in blood losses, increased energy expenditures and reduced feeding time; deep snow results in forage inaccessibility, increased energy expenditures in digging in the snow and travelling; rain in the autumn can result in an ice layer on the ground lichens; a late spring can delay the migration to the calving grounds and delay the emergence of highly digestible, new-growth parts of plants which are necessary to nourish the dam during the last days of pregnancy and during early lactation. Those climate-related factors undoubtedly affect the annual energy budget of barren-ground caribou. They also markedly affect the susceptibility of caribou to predators.

My view is that multiple factors are involved in population declines. Unfavourable combinations of natural factors over a period of years, largely climate-dependent or related, can cause tundra-dwelling populations to decrease in the absence of man (Miller et al. 1975, Parker et al. 1975, Thomas and Broughton 1978). Heavy hunting mortality coinciding with such periods probably results in the spectacular population declines periodically observed in caribou populations. Once at a low level, recovery of populations is a slow process unless conditions are optimum, a situation of low likelihood.

#### 4. Past attempts to manage barren-ground caribou populations in Canada and Alaska

There have been only modest attempts to manage the large populations of barren-ground caribou in Canada. Alaska has been much more successful and is years or decades ahead of Canada. Management of caribou has involved four areas:

1. Attempting to reduce harvests and waste
2. Predator control
3. Fire suppression on winter ranges
4. Preventing or minimizing impacts of industrial development

##### 4.1 Harvest reduction

Harvest can be reduced by the following methods:

1. Imploring or teaching users to exercise restraint
2. Legal restrictions with enforcement
3. Withdrawal of lands from hunting
4. Sociological or economic changes



#### 4.1.1 Self-restraint - education

In the late 1950's and the early 1960's there was an educational campaign in Canada aimed at reducing the waste of caribou, e.g. distribution of the pamphlet "A question of survival: The barren-ground caribou". Contact with settlements in Manitoba in the 1950's resulted in reduced harvests and less waste (Simmons et al. 1978). The effect of the program in other regions is unknown. The reduced kill of caribou during the late 1950's and early 1960's may have related more to fewer caribou, fewer dogs, and urbanization. In spite of that campaign, slaughter still occurred at Contwoyto Lake in 1960 and at Coppermine in 1974-75. The program lost impetus in the early 1960's when caribou populations began to increase and one biologist believed the Bathurst population was overutilizing its range (Ruttan 1965). The increase occurred after a major shift of people from the land to villages in the 1950's and after intensive wolf control from 1955 to 1962. The increase coincided with a revolutionary change in hunting methods on the tundra -- from dogs to snowmobiles. That changeover, which reduced the need for caribou as dog food, was much slower in forested regions of the winter ranges (Müller-Wille 1974).

In response to the new caribou crisis - the decline of the Kaminuriak herd - the Manitoba government launched a fresh educational program in 1978. That government was spurred into action by native groups in northern Manitoba who had few caribou to harvest from 1974-75 until 1979-80 when caribou returned to their region. Delegates and representatives of the user groups and the governments met in Thompson in October 1978. That first meeting permitted settlement leaders to meet one another and to air their views on caribou. The objective was to make the native people aware of the problem and obtain voluntary restrictions on harvest. A similar educational program and meeting took place in Schefferville, Quebec in May 1978. Fortunately that program had the luxury of an increasing and high population of caribou; it was not crisis action as all the others are.

An information and education program for hunters of the Kaminuriak population began in late 1978 and has gained momentum. Written materials, slide shows and discussions were held in each community. There are plans for a video presentation of the various viewpoints and a newspaper on caribou will be produced in 1981.

Simmons et al. (1979) outlined the reasons that an information and educational program was launched by the Caribou Management Group and restrictions were not imposed by the Northwest Territories Wildlife Service. They also outlined the politics which inhibit the development and implementation of hunting regulations.

#### 4.1.2 Legal restrictions

Major problems prevented the legal restrictions on harvest of caribou imposed in Canada during the 1950's and 60's from becoming effective (Kelsall 1968) and they have not disappeared today:





1. They did not apply to Treaty Indians.
2. Enforcement was almost impossible.
3. There was no support for the laws amongst native people.
4. Subsistence hunting could not be curtailed if starvation might result.

By Order-in-Council in 1960 the Northwest Territories Government declared the barren-ground caribou to be endangered. That designation gave the government the authority to restrict the kill of caribou by all peoples. For a time in the early 1960's, hunting of caribou for sport was abolished, cows and calves were protected, and waste was prohibited (Kelsall 1968). However, those laws, with few exceptions, were not enforced. Treaty Indians might claim exemption from any laws because of prior Treaty rights to hunt for subsistence. The provinces had no legislation to control hunting by Treaty Indians. Non-treaty Natives might claim exemption because of undefined Aboriginal Rights. In 1973, in a position paper, the Government of Canada conceded that native people have an interest (undefined in that document) in the land. Those rights were defined in Federal Court in 1979. In a landmark case the Hamlet of Baker Lake, the Baker Lake Hunters and Trappers Association, the Inuit Tapirisat of Canada and certain people in Baker Lake took the Government of Canada and six mining companies to court in May and June 1979 to stop mineral development within 78,000 km<sup>2</sup> in the Baker Lake region. The judgement was that the Inuit of Baker Lake had aboriginal right and title to hunt and fish in a designated region but they had no legal rights to control other activities and no proprietary rights to the land.

With land claims settled in 1971, the Alaskan Government moved swiftly in 1976 when surveys indicated rapidly declining populations. Almost overnight, through establishment of strict quotas, the kill in the Western Arctic population was reduced from 20,000-30,000 annually from 1963 to ca 3,000 (2,700-3,500) in 1976-77, and to ca 2,500 bulls in 1977-78 (Davis et al. 1978b). Illegal kills and waste were reduced to acceptable levels in both years of quotas. Hunting restrictions have been in effect for the Fortymile population since 1951. They became more stringent as the population decreased. Even before land claims, the Alaskan Government was able to restrict the harvest; quotas were in effect in 1952-55 and 1958 on the Western Arctic population.

#### 4.1.3 Preserves

One of the earliest attempts at wildlife management in the Canadian North was the establishment, primarily for muskox preservation, of Game Preserves, such as the large Thelon Game Sanctuary and the Arctic Islands Game Preserve. The general effect of these preserves was to practically eliminate non-subsistence hunting within them. The withdrawal of lands specifically for caribou management may not apply to Treaty Indians and therefore it is not an attractive option.



#### 4.1.4 Reduced hunting because of sociological or economic changes

Possibilities here are (1) regional extirpation of caribou and one or two generations of native peoples not being able to hunt and losing the tradition, (2) the anti-hunting crusade in the south could affect native people subject to southern radio and television, and (3) a decline in the birth rate.

#### 4.2 Predator control

From 1951 to 1955 wolf control was scaled up on the central mainland ranges in Canada in response to the caribou crisis identified by Banfield (1954). From 1954 to 1958, ca 2,000 wolves were poisoned annually but by 1960, in spite of the same effort, only 1,000 wolves were taken. That reduction was thought to indicate a significant decrease in wolf population. Wolf control was gradually phased out over a 2 year period ending in 1963. Wolf bounties were in effect in the Northwest Territories during the years 1924-33, 1937-39 and 1965-75 but they have proved to be ineffective in reducing wolf numbers.

There is some evidence that a decline in the Fortymile population in Alaska was reversed in the late 1940's with the introduction of wolf control. About 5 years after control was stopped in ca 1955, the caribou population began to decline again (Davis et al. 1978a). Calf survival in the Nelchina population improved after 5 years of wolf control during the late 1940's and early 1950's and it decreased again after the controls (Bergerud 1980). The data on the relationship between wolf control and calf survival in other populations of barren-ground caribou is weaker.

#### 4.3 Fire suppression

Research on the winter ranges in Manitoba, Saskatchewan, and the Northwest Territories in the 1950's and 60's indicated that fire suppression might be beneficial to caribou. Limited suppression and installation of field camps began in 1966 on an area designated as the "Caribou Range" between Lake Athabasca and Great Slave Lake. The program was gradually phased out during the early 1970's, its effectiveness not known.

#### 4.4 Preventing or minimizing the impact of industrial development

Activities of man other than hunting can have adverse impacts on caribou. Preventing those impacts is a form of management relatively new in northern Canada. Some recent developments which pose a threat to caribou include: (1) proposed pipeline and ancillary activities in the eastern and western Arctic, (2) intensive exploration and seismic programs throughout the Arctic, (3) increased use of icebreakers in arctic channels and inlets which could obstruct traditional movements, (4) road networks, constructed and proposed, across winter and summer





ranges, (5) greatly increased air traffic, including low level flights which are known to harass caribou, (6) more frequent contact with man on the ground, (7) expansion in size and number of ground facilities such as airports, mines, towns and camps.

An important precedent in safeguarding caribou range from industrial activity (mining exploration) was the 1-year freeze imposed by the Department of Indian and Northern Affairs (DINA) in March 1977 on activities in a 78,000 km<sup>2</sup> area around Baker Lake. In April 1978 the Inuit sought an injunction in Federal court to prevent the lifting of the freeze. When DINA explained that it was prepared to restrict land-use activities during certain periods in regions critical to the caribou and to monitor the effect of exploration activities on the caribou, an injunction was granted under the terms of those restrictions. The restrictions had no effect on hunting, only on industrial and other activities potentially harmful to caribou. The injunction was terminated in December 1979, but stringent controls on land use are still in effect.

## 5. Demographic and socio-political characteristics of user groups

### 5.1 Rate of growth of user populations

The 1971 census indicated the following annual rates of natural increase in northern Canada: NWT 3.7%, northern Saskatchewan 3.8% and northern Manitoba 3.4%. The rates are higher, 4-4½%, in the native villages within the caribou range. A doubling of the population will occur every 16-20 years at the present rate of births and deaths. Thus, northern populations are rapidly outstripping the caribou resource. There are too few caribou now to satisfy the traditional needs of the people within the ranges of the Kaminuriak, Beverly and Bathurst populations and perhaps in others. Within the next few years most of the caribou populations will have more demands on them than they can withstand.

### 5.2 Land claims

The form in which land claims are settled will have a profound effect on the management of caribou. In the Alaska Native Claims Settlement Act of 1971, native rights were to be extinguished within 20 years. Terms of the Agreement in Principle between the Committee for Original People's Entitlement (COPE) and the Canadian Government (1978), signed on 31 October 1978, call for exclusive and preferred native rights to harvest certain species; however, management will be retained by the NWT Government. The role of the natives in the management process was to increase in time, beginning with an advisory role. Other claims, pending, call for wildlife or caribou management to be transferred to the native people at the outset.

## 6. The value of caribou

The imputed annual value of harvesting 5% of the 1977 population



of barren-ground caribou on the Canadian mainland (770,000) was 15.4 million dollars at a replacement value of \$4.00/lb. Berger (1977) based similar calculations on \$4.00 per pound. About 100 pounds of meat is obtained on the average from a caribou and therefore each caribou is worth about \$400.00. If annual quotas of 1,000 and 3,000 caribou were applied to the Kaminuriak and Beverly populations respectively, the value of the meat would be \$400,000 and \$1,200,000 annually. It would be somewhat higher if only bulls were harvested because of their greater weight.

The cultural value of caribou to northern hunters is incalculable. Hunting is an important link to the past for northern societies that are in a period of rapid cultural change.

## 7. Why are we at the crossroads?

1. Barren-ground caribou under natural conditions are relatively unproductive.

They bear only 1 calf and most females produce their first calf at age 3 or 4 years. Only about 69 calves were produced by 100 females over 1 year of age in the Kaminuriak population, 1966-68.

2. Survival of calves is low in most years under natural conditions.

The annual survival of calves from 1966-68 in the Kaminuriak population was only about 22% and recruitment (addition of 1-year-old individuals to the population) was only 9-10%. The average survival of calves in the western mainland populations from 1947-48 to 1960-61 was about 42% and recruitment averaged 15.9% over the 14 years (Kelsall 1968). However wolves were controlled during most of that period. Bergerud (1980) concluded that calf survival in many caribou herds (populations) in North America was generally less than 50% and it was frequently only 10-20%.

3. Natural mortality of caribou older than 1 year is also relatively high.

Natural mortality was estimated at 5% annually in the Kaminuriak population, 1966-68 (Parker 1972), but recent data suggests that it was about 7% (females 5% and males 9%). Bergerud (1980) estimated that natural mortality averaged 10% (7-11%) in populations of caribou subject to normal predation and 5-6% if predators were rare.

4. The annual kill (harvest) by hunters is too high in many caribou populations.

Caribou can withstand, on the average, a low rate of harvesting if there is no control of predators because the





annual natural mortality of caribou over 1 year of age almost equals the annual recruitment. Data for the Kaminuriak population since 1966 indicates average natural mortality of 7% and recruitment of 10%, leaving an allowable harvest of only 3% in order to maintain a stable population. The estimated harvest since 1967 of caribou older than 1 year has ranged between 4,000 and 5,000 annually. As the population decreased in numbers the percentage of the population removed annually by hunting has increased from about 6.5% in 1967 to 9-10% in 1977 and to 12-13% in 1980. Even if wolves were controlled and the recruitment was raised from 10% to 15% and the natural mortality of caribou older than 1 year was reduced from 7% to 5%, the present rate of harvest would result in a 2-3% annual decrease in the population and that percentage would increase yearly.

5. The population of users of the caribou resource in northern Canada has increased and is increasing at about 4-4½% annually, a doubling every 16-20 years (Bone et al. 1973, Rea 1976).
6. Access to caribou is increasing steadily because of the building of roads into the winter ranges, the use of aircraft to spot, hunt and transport caribou, the increased use of improved snowmobiles, the use of better boats and motors, the increased use of all-terrain vehicles and four-wheeled-drive trucks.
7. Without management the Kaminuriak, Beverly and Bathurst populations will not increase as they did in the late 1950's and 1960's.

That increase was caused by a peculiar set of circumstances:

- 1) urbanization -- a shift from the land to settlements during the 1950's and early 1960's.
  - 2) a shift from use of dogs for locomotion to snowmobiles which reduced the need for caribou by up to 50%.
  - 3) wolf control, which was phased in from 1952-55 and phased out in the early 1960's.
  - 4) restrictions on the hunting and use of caribou.
  - 5) information programs.
8. A reduction in caribou numbers does not necessarily lead to reduced harvests.

All or most of a population may periodically pass near one of the many villages within the range of a population. The general rule of decreased hunting effort with diminishing



numbers does not necessarily apply to caribou because of the caribou's movement patterns, the vulnerability of caribou to hunting and the improved access and hunting gear.

9. Hunters do not readily perceive that caribou numbers have decreased or that a problem exists.

Relatively large numbers of caribou are periodically accessible to villages as explained in the above point.

10. There is a tendency to take as many caribou as possible when the opportunity arises.

Large community freezers and personal freezers now permit the people to store caribou during the warm months. In the past the survival of many of the inland groups of hunters probably depended on them securing large numbers of caribou at certain periods of the year because of the unpredictable nature of caribou movements within their range. In some years surplus caribou obtained by one band or group was utilized by other less fortunate groups.

11. A shift to a wage economy does not necessarily reduce the harvest; it could have the opposite effect for wages can be used to charter aircraft and purchase good hunting equipment for weekend and free-time hunts at great distances from the settlements.
12. Barren-ground caribou are one of the most difficult species to manage.

The ranges are vast, often two or more cultural groups and governments are involved, many communities utilize the population, the acquisition of the necessary biological information is exceedingly costly. The participation of hunter groups in management decisions was not possible until recently because they had no organized groups to represent them, except at the village level.

13. The land claims issue, increased emphasis on regional self-determination, industrial activities on the caribou ranges, and the legal actions in the past 2 years have tended to polarize attitudes which has hindered resolution of the problem.
14. Educational programs are necessary before quotas and other forms of management will be respected by the hunters.

Such programs will take several years to implement and take effect. Meanwhile some caribou populations could decrease to such low numbers that recovery to historical levels could take several decades.





15. The killing of caribou to secure antlers in the velvet for sale to Oriental buyers is a potential source of additional mortality if it is not controlled.

## 8. Conclusions

The barren-ground and Peary caribou in northern Canada are some of the large land mammals in North America that are managed poorly, largely because of inadequate enforcement. The major form of wildlife management practiced throughout the world is hunting restrictions. The decreasing populations of relatively unproductive caribou and the rapidly increasing population of users, with better access and equipment, means that the user group has outstripped the caribou resources of most regions in northern Canada. Management must be instituted before the populations sink to an insignificant level. Hunting restrictions and wolf control are necessary to allow the populations to increase in the next one or two decades to a level where the annual allowable harvests can be increased. However, as the population of users increases, the caribou can never again supply all the needs of the people.

The management of barren-ground caribou will be very costly. However, the caribou resource is extremely valuable as a supply of meat and invaluable as a link with the past for peoples in rapid transition.

The data used in this analysis are imperfect but they are better than much of the information used to manage large land mammals in southern Canada. Many of the counts of caribou numbers and sex and age proportions are subject to an error of  $\pm 20\%$  but the trends established by those data are distinct and irrefutable. Harvest statistics are even less accurate.

The objectives of the hunters, the biologists and the managers are the same: to see the caribou populations flourish in northern Canada so that the tradition of hunting and, in part, living off the land can be maintained. With cooperation by all parties and wise land-use policies there is no reason why that objective cannot be attained.

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